

# Logarithms

$$b^x = n \longleftrightarrow \log_b n = x$$

### Exponent Rules

$$x^a \cdot x^b = x^{a+b}$$

$$\frac{x^a}{x^b} = x^{a-b}$$

$$(x^a)^b = x^{ab}$$

$$x^{-a} = \frac{1}{x^a}$$

$$x^{\frac{1}{a}} = \sqrt[a]{x}$$

$$x^0 = 1$$

### Logarithm Rules

$$\log_x a + \log_x b = \log_x ab$$

$$\log_x a - \log_x b = \log_x \frac{a}{b}$$

$$\log_x a^b = b \log_x a$$

$$\log_x \frac{1}{a} = -\log_x a$$

$$\log_x \sqrt[a]{x} = \frac{1}{a}$$

$$\log_x 1 = 0$$

### Special Logs

Common Log:  $\log x = \log_{10} x$

Natural Log:  $\ln x = \log_e x$

### Change of Base Formula

$$\log_x a = \frac{\log_n a}{\log_n x} = \frac{\log a}{\log x} = \frac{\ln a}{\ln x}$$

### Examples

1.  $\log_2 64 = 6$  because  $2^6 = 64$
2.  $\log_3 9 = 2$  because  $3^2 = 9$
3.  $\log_3 \frac{1}{9} = -2$  because  $3^{-2} = \frac{1}{9}$
4.  $\log_{\frac{1}{3}} 9 = -2$  because  $\frac{1}{3}^{-2} = 9$
5.  $\log_2 8 = 3$  because  $2^3 = 8$
6.  $\log_8 2 = \frac{1}{3}$  because  $8^{\frac{1}{3}} = \sqrt[3]{8} = 2$
7.  $\ln e^{4x} = \log_e e^{4x} = 4x$
8.  $\log_4 8 = \log_4 (2 \cdot 4) = \log_4 2 + \log_4 4 = \frac{1}{2} + 1 = \frac{3}{2}$
9.  $\log_4 8 = \log_4 (16 \div 2) = \log_4 16 - \log_4 2 = 2 - \frac{1}{2} = \frac{3}{2}$
10.  $\log_4 8 = \log_4 (2^3) = 3 \log_4 2 = 3 \left(\frac{1}{2}\right) = \frac{3}{2}$

### Compound Interest

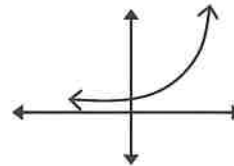
$$A = P \left(1 + \frac{r}{n}\right)^{nt}$$

$$A = Pe^{rt}$$

### Inverses

$$b^{\log_b x} = x$$

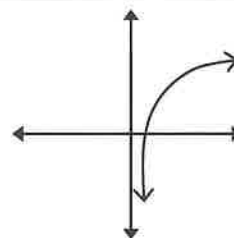
$$\log_b b^x = x$$



**Exponential**

$$f(x) = b^x$$

**D:**  $(-\infty, \infty)$   
**R:**  $(0, \infty)$



**Logarithmic**

$$f(x) = \log_b x$$

**D:**  $(0, \infty)$   
**R:**  $(-\infty, \infty)$

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Algebra 2  
Log Test Review

Write each logarithm in exponential form.

1.  $\log_4 16 = 2$

2.  $\log_2 32 = 5$

3.  $\log_{14} 196 = 2$

Write each exponential equation as a logarithmic equation.

4.  $7^3 = 343$

5.  $2^{-2} = \frac{1}{4}$

6.  $e^4 = 54.5981$

Evaluate the logarithm **without** a calculator.

7.  $\log_3 9$

8.  $\log_7 7$

9.  $\log 1000$

10.  $\log_{13} 1$

11.  $\log_3 \frac{1}{9}$

Fill in the blanks.

12.  $\log(u) + \log(v) =$  \_\_\_\_\_

13.  $\log(u) - \log(v) =$  \_\_\_\_\_

14.  $\log u^n =$  \_\_\_\_\_

15.  $\log_b b^n =$  \_\_\_\_\_

16.  $\log_a b^n =$  \_\_\_\_\_

17.  $\log_a 1 =$  \_\_\_\_\_

18.  $\log_a a =$  \_\_\_\_\_

Use the change-of-base rule to evaluate the logarithm.

32.  $\log_8 15$

33.  $\log_{12} 7$

Solve for x.

34.  $6^{-2x} - 3 = 7$

35.  $e^{0.08x} = 0.3$

36.  $\log_4(x + 3) = -2$

37.  $\log_5 4x + \log_5 x = 3$

38.  $10^{3x+5} = 10^{x-3}$

39.  $2e^x - 1 = 9$

40.  $\ln 4x = \ln(x + 6)$

Be sure that you know how to graph a logarithm also.

Using  $\log 2 = 0.301$  and  $\log 3 = 0.477$ , evaluate the following. SHOW the rule and the answer.

19.  $\log 6$

20.  $\log \frac{2}{3}$

21.  $\log 4$

22.  $\log 9$

23.  $\log 12$

24.  $\log 18$

Expand the expression.

25.  $\log 3x$

26.  $\log \frac{7}{y}$

27.  $\log x^2y$

28.  $\log_2 (8x - 1)^2$

Condense the expression.

29.  $\log 12 - 2\log x$

30.  $3\log x + \log y - \log z$

31.  $7\log z + \log y$